

Glass-Body Design Organization & Status

for the LAPPD Mechanical Group
Bob Wagner, Argonne National Laboratory
Hermetic Sealing Godparent Review
Tuesday 26 April 2011

All Glass Option

Goals:

- ▶ Use **inexpensive** borosilicate glass for containment vessel
- ▶ Avoid use of pins penetrating glass for HV and signal
- ▶ Cheap, reliable, reproducible containment vessel fabrication
- ▶ Demonstrate feasibility with partially active mock-up

Constraints:

- ▶ Support vessel against implosive atmospheric pressure
- ▶ Top photocathode window seal at low temperature ($<120^{\circ}\text{C}$)
- ▶ ~10 year stability for seal with small leak rate
- ▶ Minimize handling steps in fabrication
- ▶ Avoid particulates in vacuum space
- ▶ Materials chemically compatible with alkali metal photocathode

Glass Body Design Organization

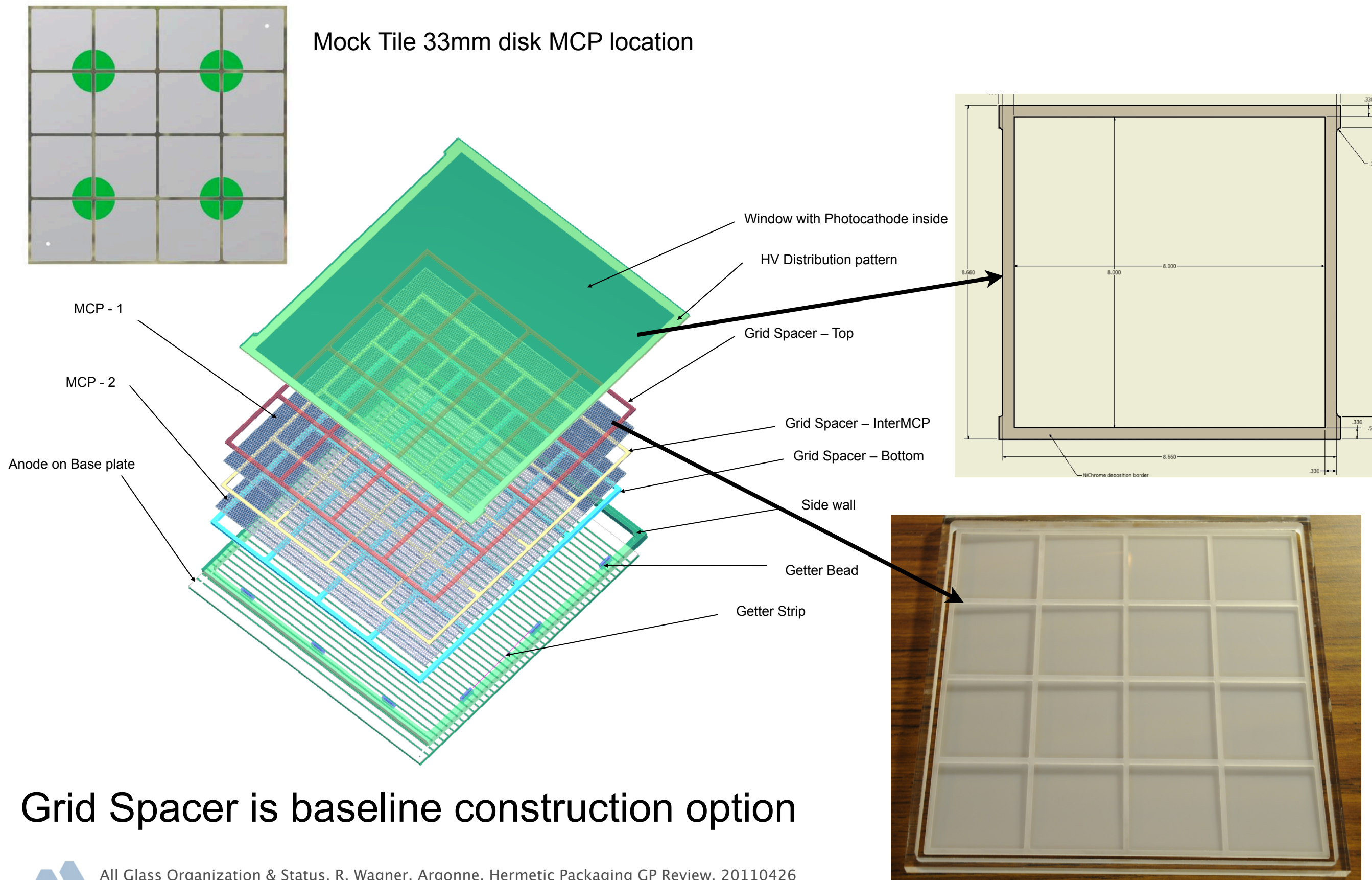
▶ People

- Argonne -- Joe Gregar, Dean Walters, Bob Wagner
- Chicago -- Henry Frisch, Rich Northrop
- Univ. Illinois/Chicago -- Marc Kupfer, Ernesto Indacochea, Alcides Raraz
- Minotech -- Michael Minot, Malcolm Chamberlain

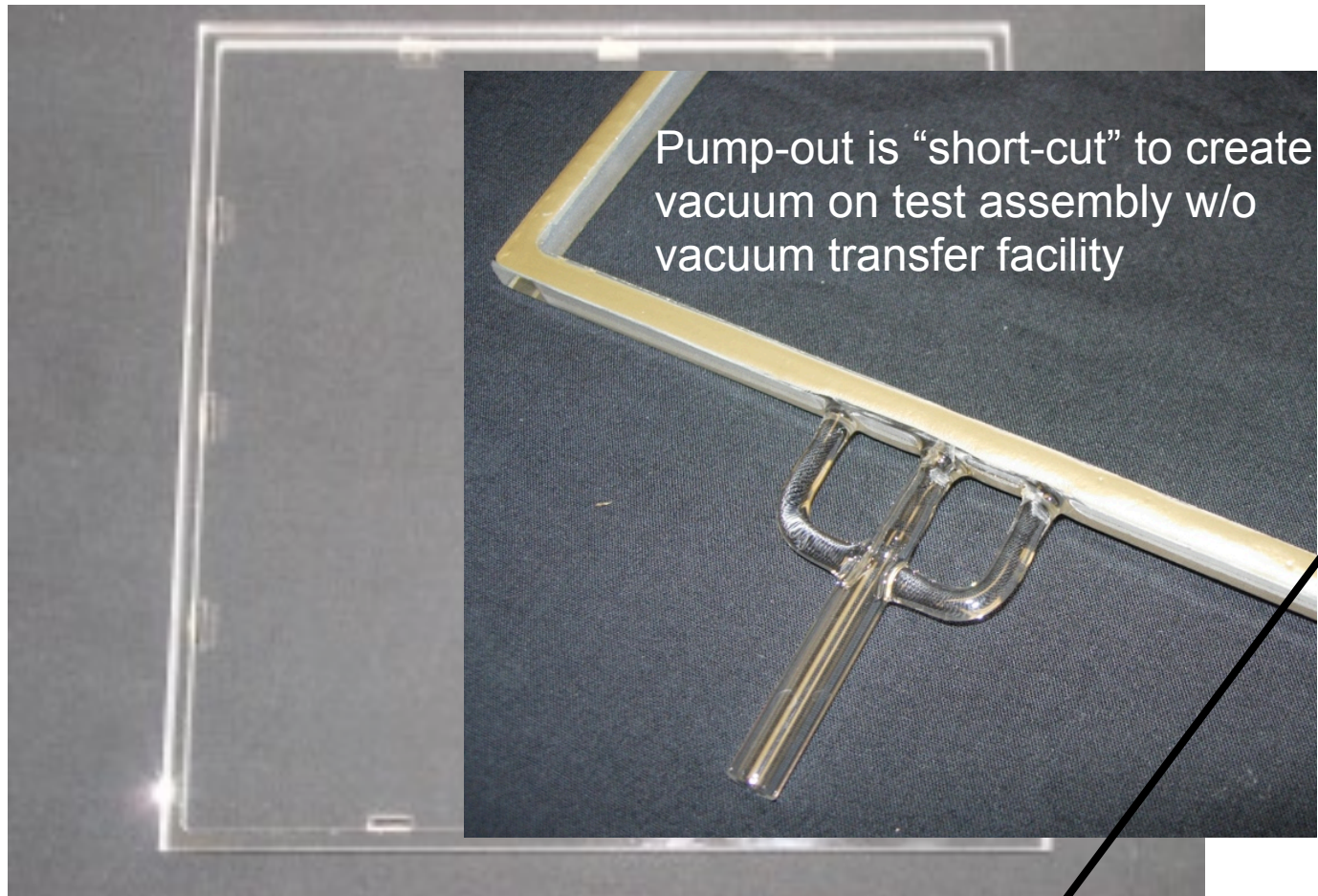
▶ Components

- Enclosure
 - Bottom Plate with anode strip lines -- Driven by needs of electronic readout group; fabricated by outside glass shop(s)
 - Sidewall -- Fabricated by outside glass shops
 - Top Plate -- Photocathode surface; HV attachment
- Internals
 - Grid Spacers -- Water-jet cut at outside glass shops
 - MCPs -- Incom, Inc. (to be covered Saturday)
 - Mock MCPs -- 8"×8" bare glass with 4 holes for locating 33mm MCP; takes place of full MCP plate
 - Getter holders -- Rectangular glass tubing attached to sidewall to hold non-evaporative getter strip (NEG) and locate/constrain Grid Spacers and MCP

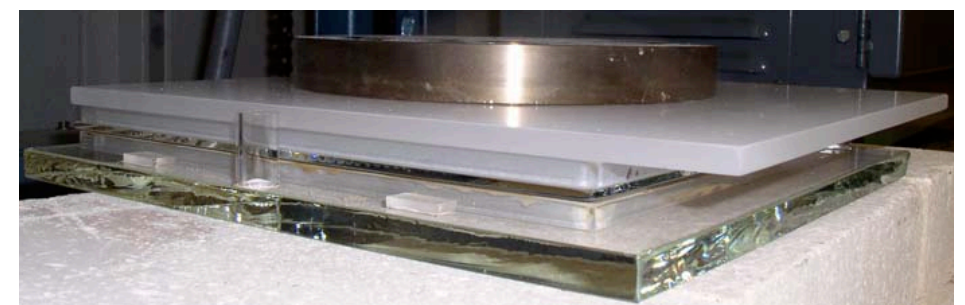
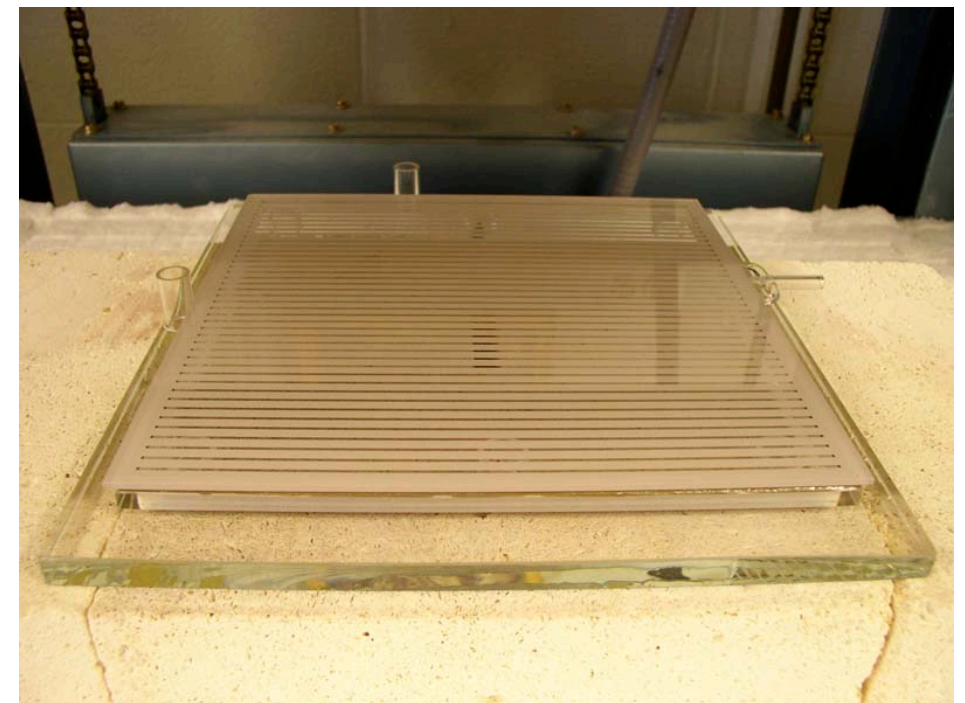
All Glass Option --- Grid Spacer Alternative



Tile Base Assembly -- Anode Bottom Plate & Sidewall



- Develop technique to reproducibly bond sidewall to bottom anode plate
 - Center sidewall frame w.r.t. bottom plate; 2 sides flush, equal overhang on anode ground strips
 - Attach getter holder tubes



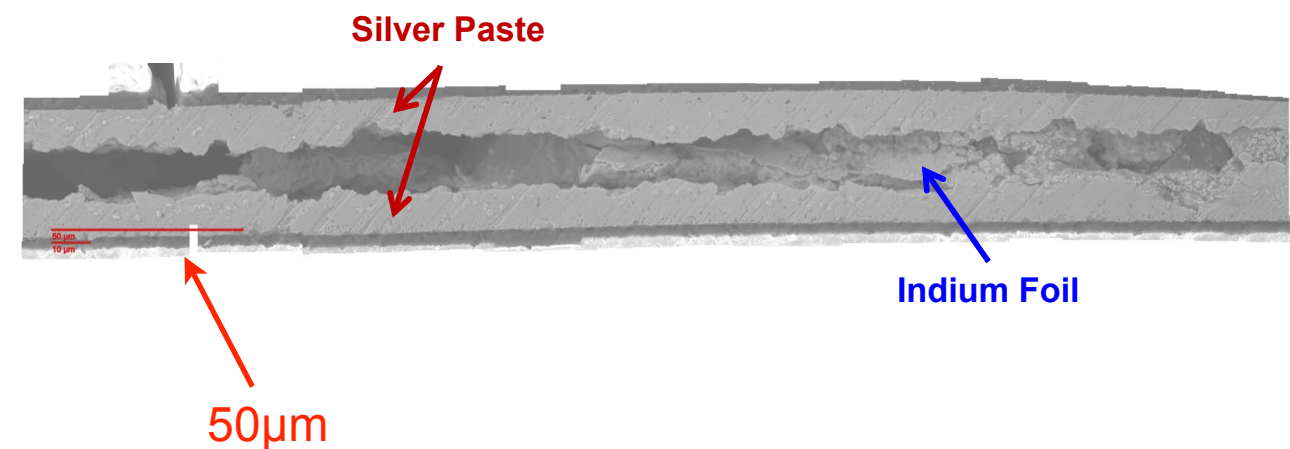
Original steel fritting fixture replaced with much simpler all glass devised by Joe Gregar

Sidewall bonds on alternating silver strips and bare glass gaps. Extension of strip past sidewall for bridging between tiles & readout connection.

Indium Thermopressure Top Window Seal

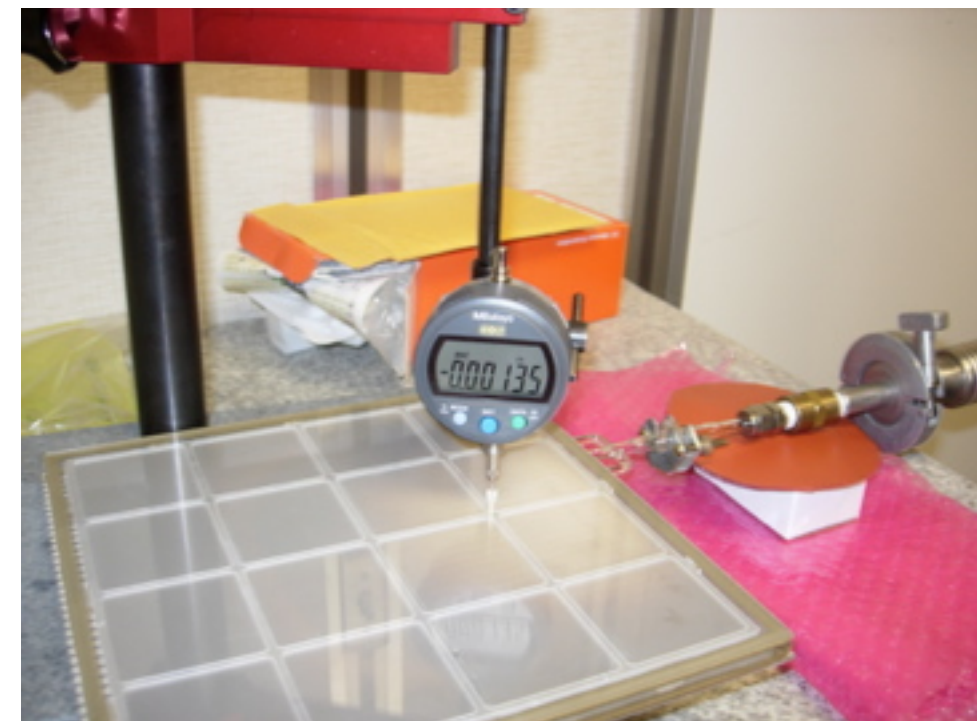
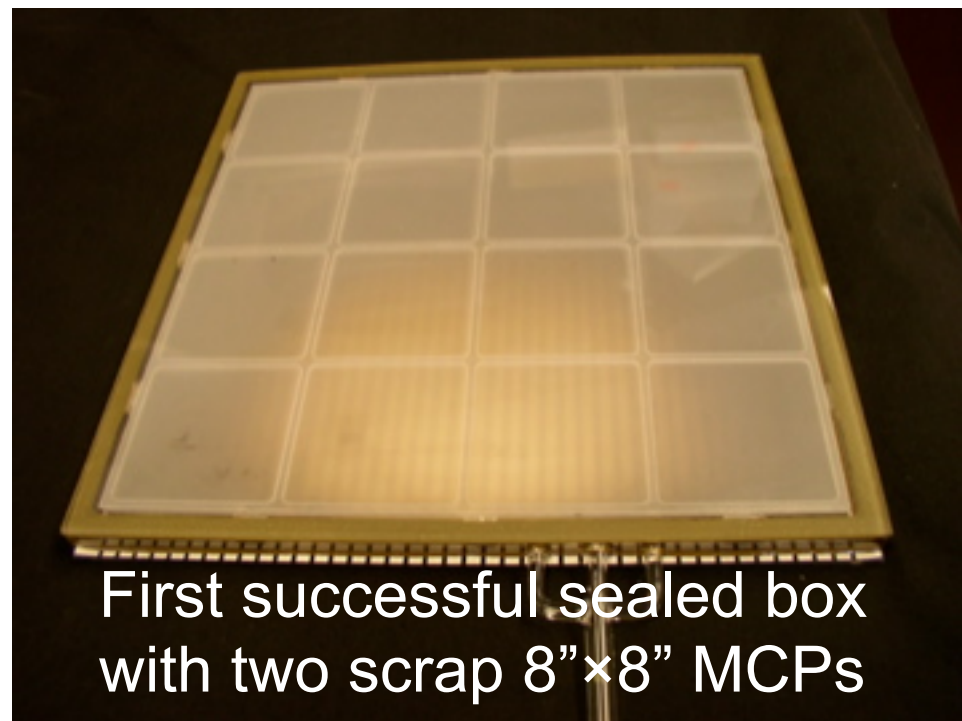
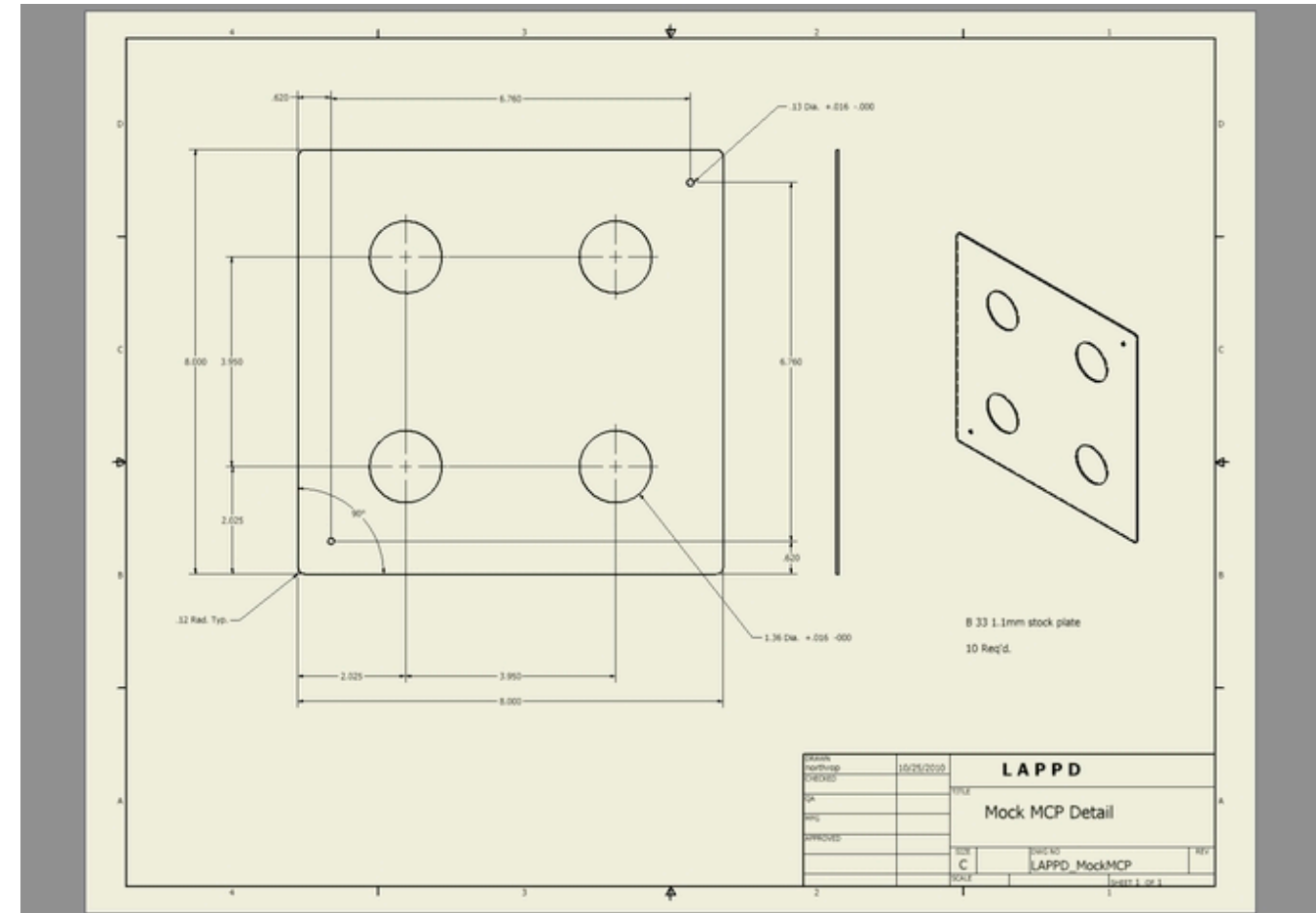
- Collaborative effort with Univ. of Illinois- Chicago (Ernesto Indacochea, Alcides Raraz, Marc Kupfer); Dean Walters overseeing work at Argonne
- **Bonding of top plate to sidewall must be low temperature ($\leq 120^{\circ}\text{C}$) to avoid damage to photocathode**
 - Test indium cold/warm press seal to silver or nichrome films on glass
- Vacuum test chamber constructed at Argonne by Dean and Marc to develop techniques on 1"×1" sidewalls and plates (see Marc's talk)
- Scope:
 - Can we achieve acceptable leak rate
 - What material to use
 - Pressure/Temperature/Time for seal
 - Scaling to full-size window
 - Long term stability

Successful Glass-Ag-In-Ag-Glass seal
1"×1" silver ink printed glass coupons
1000psi for 5 min., 160°C



Mock Tile Fabrication

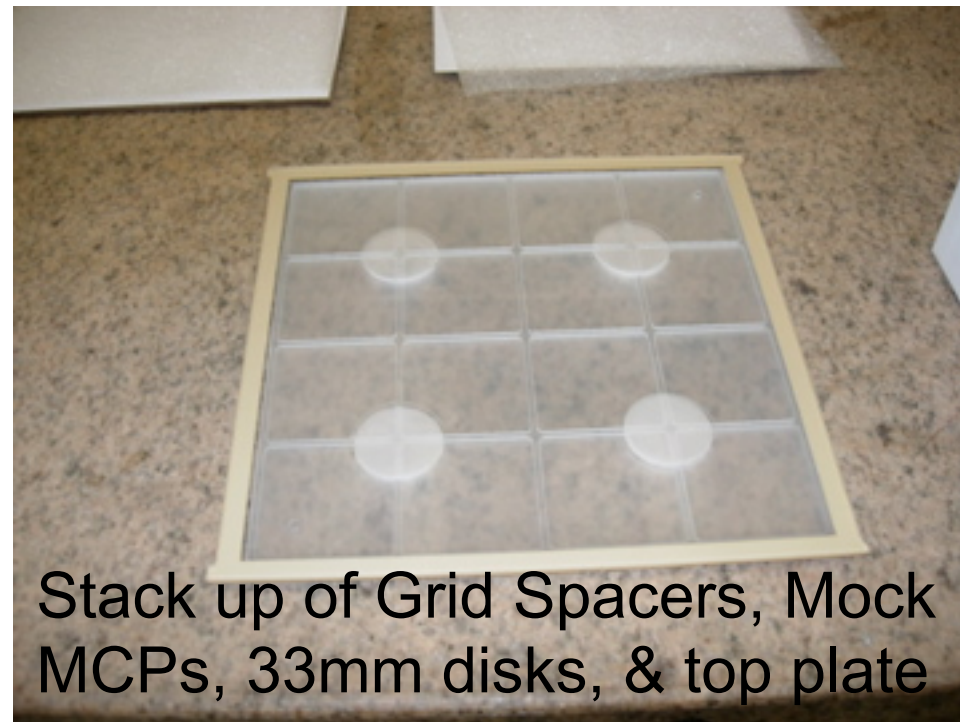
- ▶ Short-cut to testing full assembled large area MCP-PMT
- ▶ Glass 8"×8" Mock MCP w/4 holes for 33mm functional MCP pairs
- ▶ Use tile bases with pump-out port on sidewall & standard anode bottom plate
- ▶ Top window with Al photocathode
- ▶ Top seal with glass frit (like bottom seal)



Mock Tile Fabrication - Grid Spacer Compression Test

- ▶ Do Grid Spacers break if step from Mock MCP to 33mm MCP?
- ▶ Compression test mock Mock stack on granite table
- ▶ Composition:
 - 1.1mm bottom grid
 - Mock MCP plate plus 4 33mm disks of thickness 1.32mm
 - Repeat grid, Mock MCP, and disks
 - 1.1mm grid
 - top plate

Gives confidence to our ability to make a compressive stack for working Mock Tile

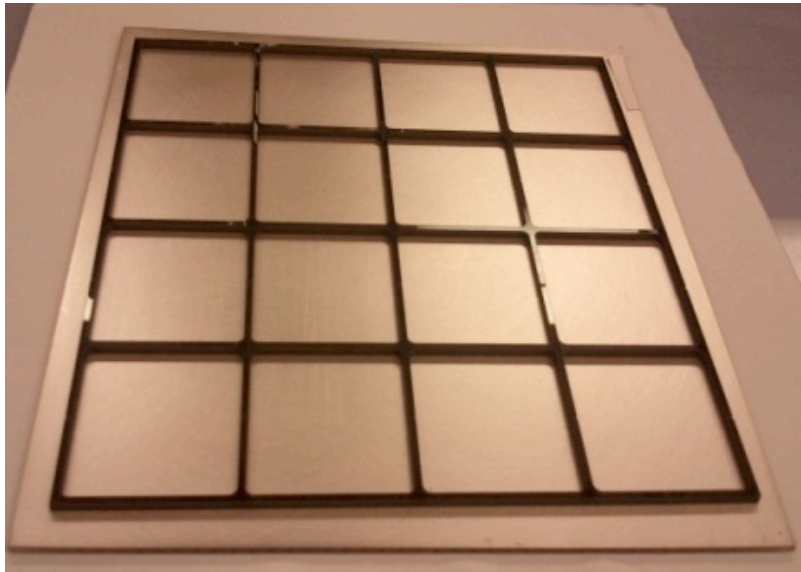


Stack up of Grid Spacers, Mock MCPs, 33mm disks, & top plate

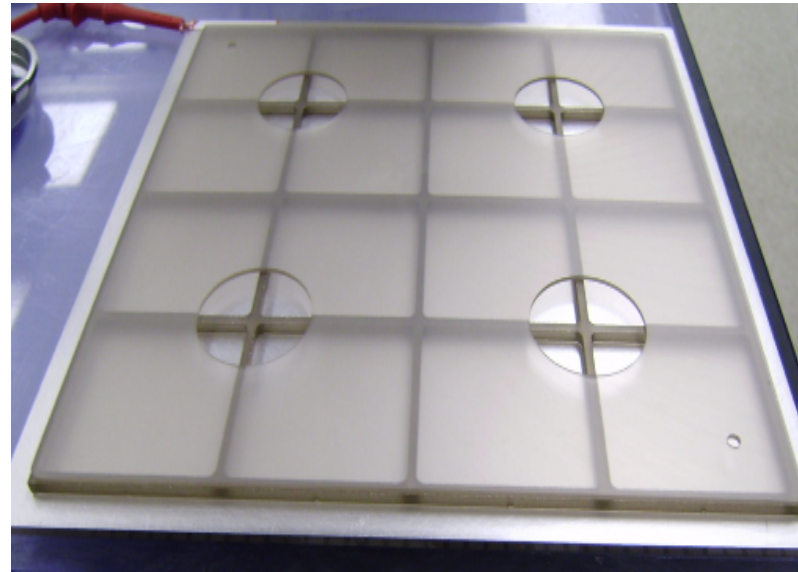


198 lbs. stacked on assembly. Nothing breaks!

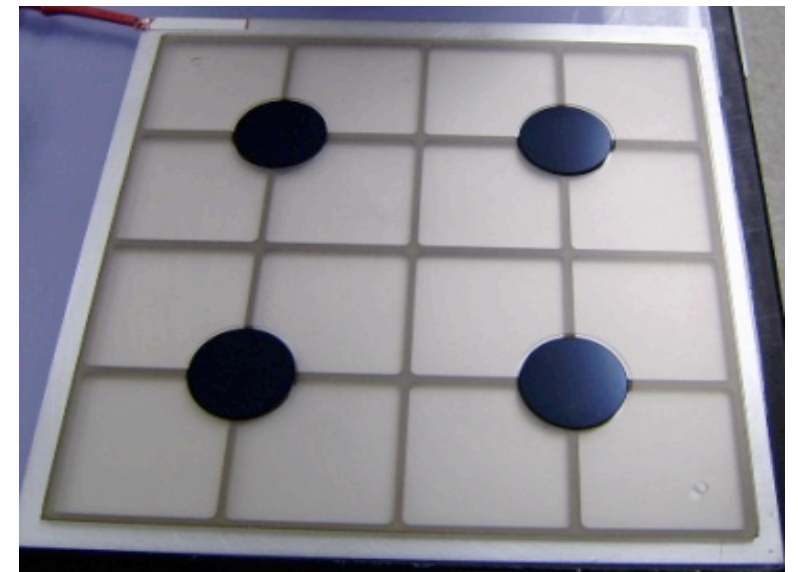
Mock Tile Fabrication -- Assembly



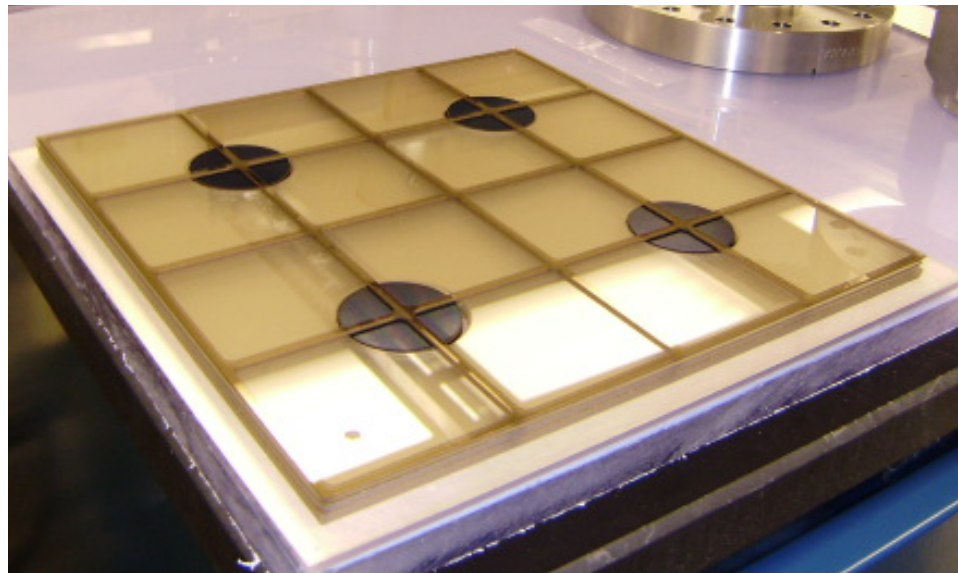
2.97mm bottom Grid Spacer



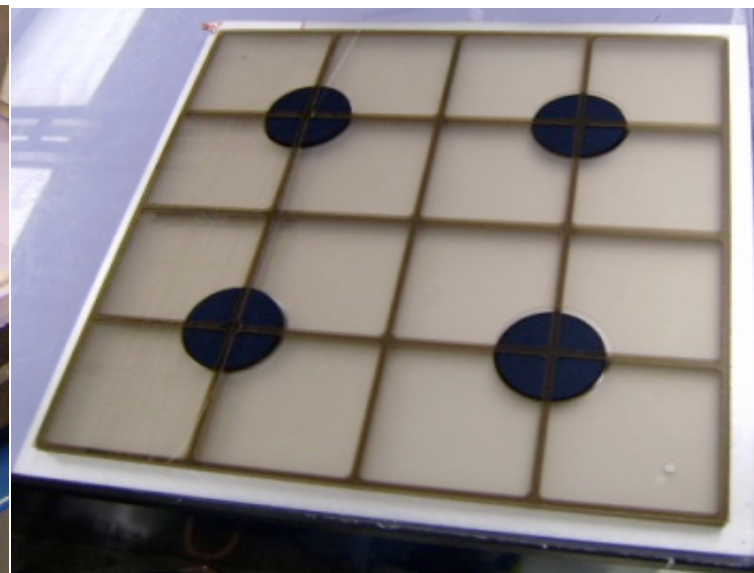
Add Mock MCP



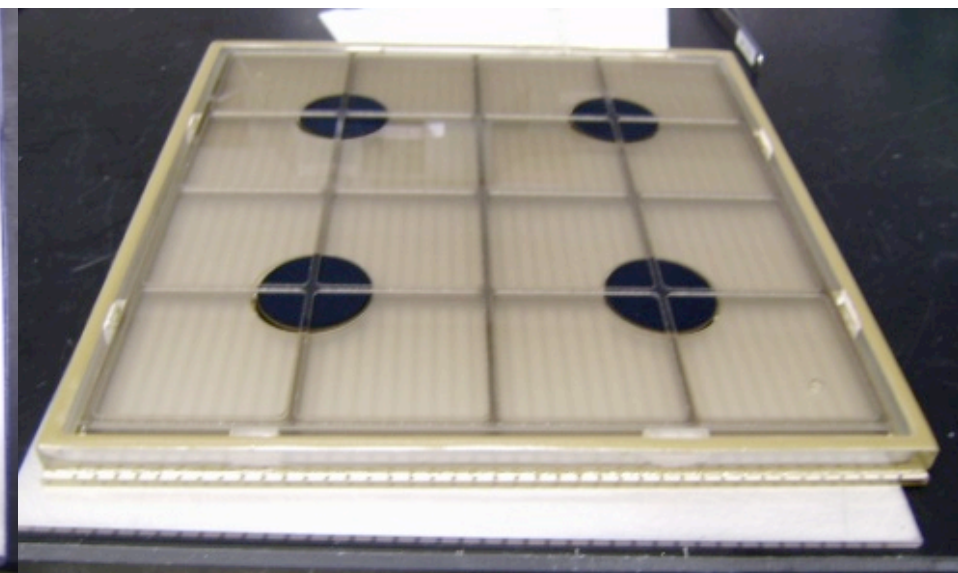
Add 33mm Functionalized MCPs



Add 1.1mm Grid Spacer

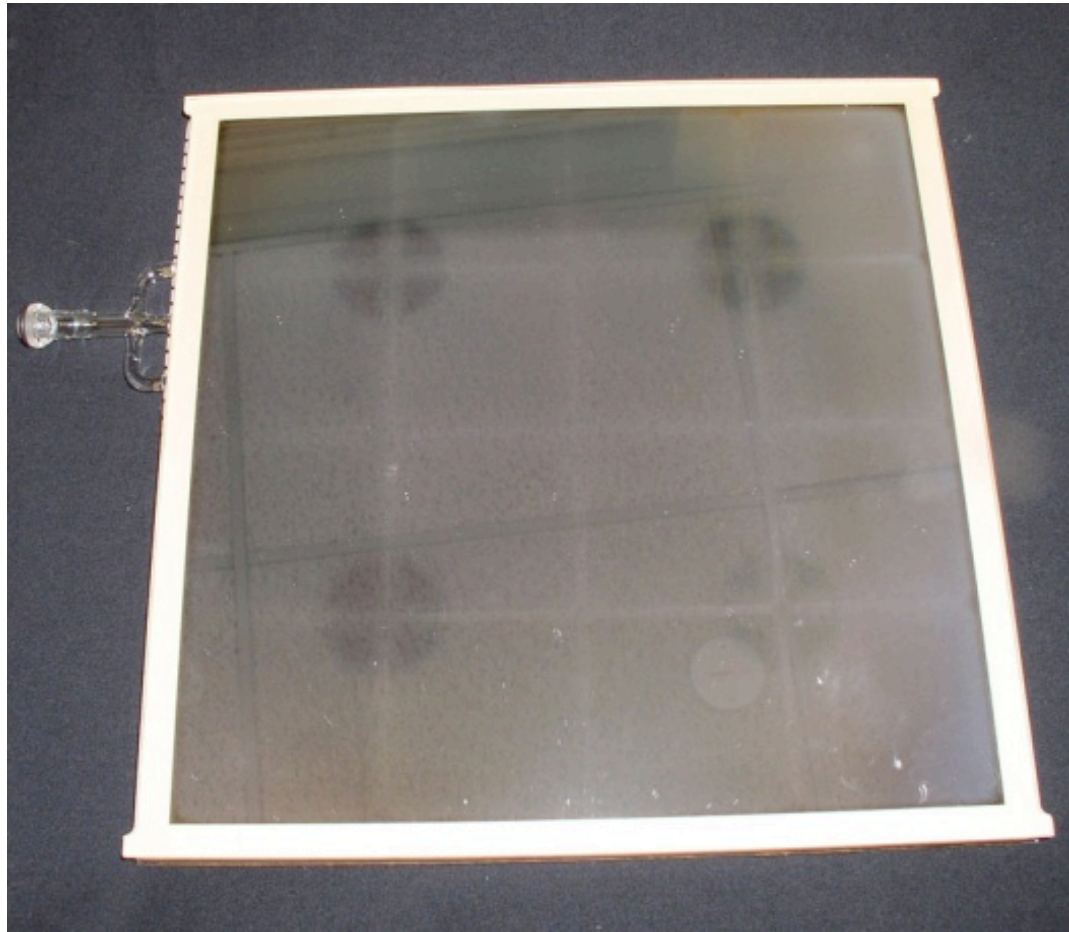


Add Mock MCP,
33mm MCPs and top
1.1mm Grid Spacer



Full stack in Tile Base

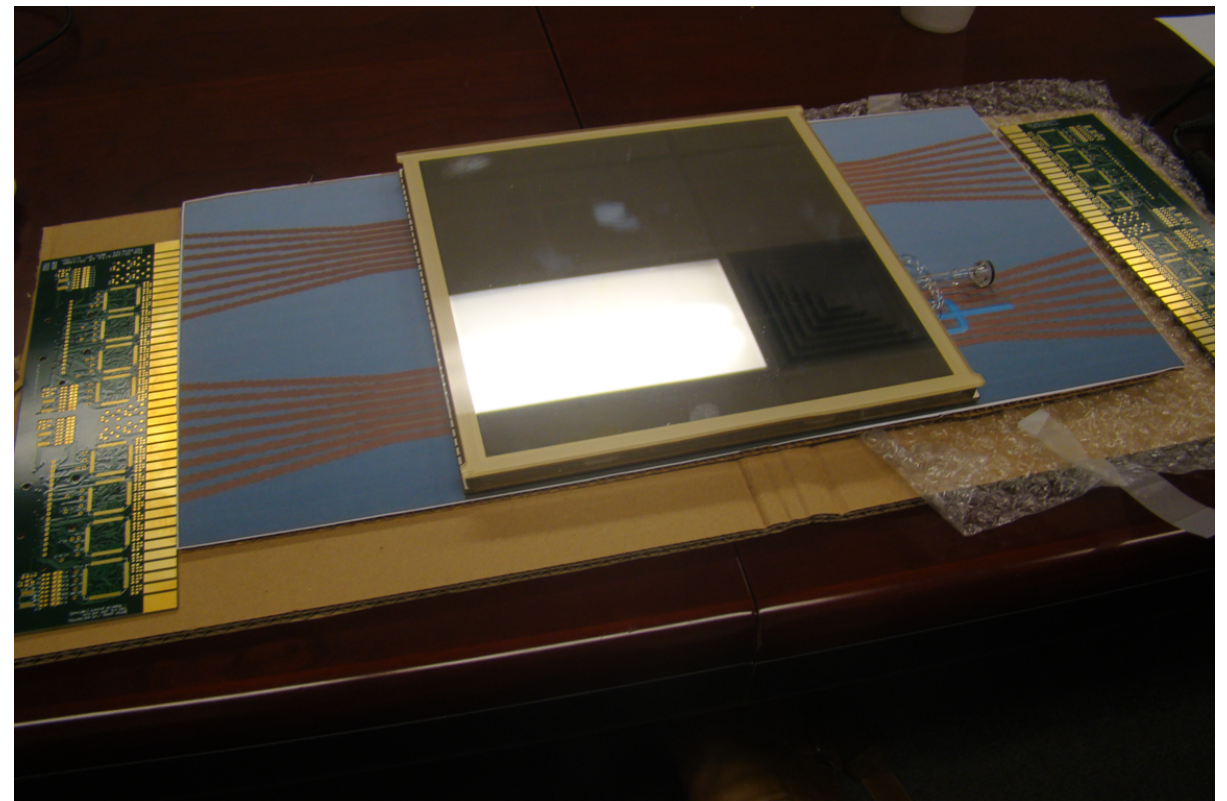
Mock Tile Fabrication -- Firing and Vacuum Testing



Mock Tile after firing to bond top plate with aluminum photocathode



Top plate deflection 0.002"+
on pump down



Mock layout for testing

Mock Tile -- Lessons Learned (So Far)

- ▶ Bottom plate, Stack, Top Plate all in **compression** to avoid breaking Top or Bottom Plate.
 - Maximum deflection unknown: 0.002" okay, 0.006" breaks
 - Top Plate contact is set by internal stack height **not** sidewall
- ▶ Tight tolerance for stack height and sidewall interior -- $\leq 0.005"$
- ▶ 1.1mm Grid Spacers are too fragile for handling.
 - Have opted for minimum of 2mm Grid Spacer
 - Change sidewall height from 6.5mm to 9mm. Accommodates both 1.2mm (20 μ m) and 1.6mm (40 μ m) MCP plates
- ▶ Measure each Grid Spacer and 33mm MCP layer individually and as added to stack and make sure it conforms to expectations
- ▶ May need to electrode Grid Spacer top and bottom surface after ALD coating

Glass-Body Status

- ▶ Successful construction of first Mock Tile. Plans for testing at APS Laser Station in progress
- ▶ Arrival of ten 8"×8" glass capillary plates enables proceeding to prototypes with full size MCPs
 - 3 parallel paths: paired 40μm MCP tile, paired 20μm MCP tile, single MCP tile
- ▶ Tile base fabrication is routine operation. Maybe close to same for stack up of internals
- ▶ Need to obtain several sizes of getter holder tubing
 - No experience yet with adding getter to internals
- ▶ Grid Spacer ALD coating has gone well; may need some resistance tweaking
- ▶ "Warm" top seal technique development is progressing with small samples (see Marc's talk)
- ▶ Chicago electronics group re-evaluating anode plate strip spacing

BACKUP SLIDES